DOE/EM Criticality Safety Program Collaborative Activities with the NCSP

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DOE/EM Criticality Safety Technology Needs and Operational Improvements

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1. Technology Needs originally summarized in the 2002 survey performed by Jerry McKamy for EM1 and published as: *Analysis of Nuclear Criticality Safety Technology Supporting the Environmental Management Program.*

2. Needs addressed in the areas of differential data; sensitivity methods & data; including demonstrations & tutorials at EM sites; and subsequent definition of integral experiments. Wilson & Westfall updated needs in 2003 – 2007 with EM site visits & program interviews.

3. In 2008 a comprehensive EM Needs survey was performed and additional areas of NDA technologies, chemical data development, and criticality accident characterization were added to Needs for differential and integral nuclear data.

DOE/EM Criticality Safety Technology Needs and Operational Improvements

1. Technology Needs addressed include cross section measurement and/or evaluation for isotopes of Actinides (Th, U, Np, Pu, Am), Structural/Storage Materials (Fe, Ni, Cr, Mn, Ca, Al, Zr, Cu, Si, Ti, Pb), Solutions (H, O, N, Cl, Fl, Ce), Absorbers (Gd, Cd, B, Ti, Na, K) & Fission Products

2. Sensitivity Applications addressed included WIPP (TRUPACT); Hanford (Tanks & Drums); INL (ISFS), SRS (Pu/Gd & Na/Ti Apps); ORO (ETTP/NDA & Isotek/U-233)

3. For relevance to EM applications, the sensitivity/ uncertainty methodology has been applied to many previously-performed integral experiments (critical & subcritical), and it is being utilized in the design of additional integral experiments (Valduc, Sandia, DAF).

4. Progress summarized in January 2011 report: *DOE/EM Criticality Safety Needs Assessment,* Westfall & Hopper, ORNL/TM-2010/97(E-mail distribution 2/23/2011 to >300).

DOE/EM Criticality Safety Technology Needs and Operational Improvements

Beginning in February, 2008, DOE/EM has sponsored 8 NCS Workshops to define and address potential OPERATIONAL IMPROVEMENTS and NCS Training in Special Topics, as well as TECHNOLOGY NEEDS Areas addressed included 11 Topic Needs:

1. Consistency Between DOE Orders, Standards & Guides* (*Ongoing Areas of Activity)
2. Criticality Safety Evaluations*
3. Mass Characterization Processes (White paper to DOE)
4. Repository for NCS Evaluations*
5. Material Transfer Evaluation Consistency (Closed - Not complex-wide issue)
6. CAAS Evaluation Methodology (White paper to DOE)
7. Experiments & Data Evaluation (TECHNOLOGY NEEDS)*
8. Use of Nonconformance & Corrective Action Data (Deferred - because response not evident)
9. DOE Contracting Practices (White paper to DOE)
10. Shortage of NCS Qualified Workers*
11. Management Support for NCS Resources*

DOE/EM Criticality Safety Technology Needs and Operational Improvements

Conclusion: Interest/Effort continues in addressing technology needs (particularly, nuclear data, CAAS, NDA and chemical data),

as well as, instituting the opportunities for operational improvements (particularly, consistency in orders, standards & guides)

Again, a more complete presentation of the DOE/EM NCS Program accomplishments is given in: *DOE/EM Criticality Safety Needs Assessment*, ORNL/TM-2010/97, January 2011.

Nuclear Criticality Safety Technical Needs
EM-21 Workshop, June 2011

Summary of Needs for Differential Data Development

	DOE Site & Task (Organization)	Technical Area	Material(s) & Isotopes	Fiscal Year Required	Priority
1.	SRS – 12 (Parsons)	DD, Measure thermal cross sections for Ti, evaluate uncertainties	Actinides plus Monosodium Titanate MST Salt Waste	CY-2009	High
2.	SRS – 9 (SRNS)	S/U, DD analysis of Pb reflection on shipping container	Pb uncertainty data testing	CY-2010	Medium
3.	SRS – 10 (Parsons)	DD, Measure thermal cross sections for Na, evaluate uncertainties	Actinides plus Monosodium Titanate Salt Waste	CY-2010	Medium
4.	SRS – 7 (WSRC)	DD, Measure Gd cross sections in fast neutron spectra.	Non-MOX Pu Disposition with absorbers	November, 2009	Low
5.	SRS – 5 (WSRC)	DD, examine uncertainty data for Pu in glass with absorbers: Fe, Gd, Na, Mn, B, Si	Non-MOX Pu Disposition with absorbers	November, 2009	Low
6.	SRS – 1 (SRNS)	DD, examine uncertainties and/or measure thermal and epithermal cross sections	Mo-HEU (20 & 93% U-235), research reactor fuel in reprocessing	January, 2009	Low
7.	ORO – 4 (Isotek)	BD & DD, Upgrade U-233 solution benchmarks – SCALE & MCNP validations	U-233 in 11 critical solutions, new SCALE technologies, MCNP models and cross sections	FY-2008	High

Notes: BD = Benchmark Data, DD = Differential Data, S/U = Sensitivity/Uncertainty

Nuclear Criticality Safety Technical Needs
EM-21 Workshop, June 2011
Summary of Needs for Integral Data Development

	DOE Site & Task (Organization)	Technical Area	Material(s) & Isotopes	Fiscal Year Required	Priority
1.	ORO - 3 (Isotek)	ID, BD, Critical & subcritical experiments performed & benchmarked	U-233 in intermediate neutron energy spectra	FY-2008	High
2.	SRS – 13 (Parsons)	ID, BD, Subcritical, critical experiments for Ti in thermal neutron spectra	Actinides plus Monosodium Titanate MST Salt Waste	CY- 2009	High
3.	SRS – 11 (Parsons)	ID, Subcritical, critical experiments for Na in thermal neutron spectra	Well defined amount of Na in thermal systems	CY-2010	Medium
4.	SRS – 4 (WSRC)	ID, experiments for Pu in glass DWPF spectra with absorbers: Fe, Gd, Na, Mn, B, Si	Non-MOX Pu Disposition with absorbers	November, 2009	Low
5.	SRS – 14 (SRNS)	ID, BD, Subcritical, critical experiments for Mo in thermal neutron spectra, (Uranyl Nitrate Soln.)	Mo-HEU (20 & 93% U-235), research reactor fuel in reprocessing	January, 2009	Low
6.	PPPO – 1 (EM/Paducah)	CD, ID , Modeling assistance in characterizing fissile materials in landfills	U mass limits as a function of enrichment, compounds & admixed materials	FY-2010	Low

Notes: BD = Benchmark Data, CD = Chemical Data, ID = Differential Data

Nuclear Criticality Safety Technical Needs
EM-21 Workshop, June 2011
Summary of Needs for Non-Destructive Assay (NDA) Technologies

	DOE Site & Task (Organization)	Technical Area	Material(s) & Isotopes	Fiscal Year Required	Priority
1.	Hanford – 2 (TRU & CERCLA)	NDA Techniques and integral data	Actinides (CERCLA)	?	High
2.	West Valley – 1 (Decommissioning & TRU Waste)	NDA, in-situ fissionable assay in high-gamma field	LEU, Pu >15% Pu-240 (Spent fuel & waste forms)	FY09	High
3.	West Valley – 2 Decommissioning & TRU Waste)	NDA, fissionable assay in high-gamma or TRU waste stream	LEU, Pu >15% Pu-240 (Spent fuel & waste forms)	FY09	High
4.	ORO – 2 (Isotek)	NDA, technology needed for both containers and process equipment holdup	U-233, U-235, Gd, Cd as oxides, fluorides	FY-2011	Medium
5.	PPPO-6 (EM/PGDP & PORTS)	NDA, Evaluation criteria for assessment of NDA programs	U cascade operation, D&D applications	?	High
6.	PPPO-7 (EM/PGDP & PORTS)	NDA, Determination of uncertainty values for DNA measurements	U cascade operation, D&D applications	FY-2009	High
7.	ORO – 6 (ORNL -Proposed Work)	TM, advanced fixed neutron-gamma source transport methods	Actinides analyzed for NDA and/or subcritical assembly purposes	FY-2011	Medium

Notes: NDA = Non-Destructive Assay, TM = Transport Methods

Nuclear Criticality Safety Technical Needs
EM-21 Workshop, June 2011

Summary of Needs for Chemical Data Development

	DOE Site & Task (Organization)	Technical Area	Material(s) & Isotopes	Fiscal Year Required	Priority
1.	ORO – 5 (ORNL - Proposed Work)	CD, chemical data to better characterize actinides & absorbers in solution	U, Pu, absorbers in solutions, temperature & molarity	FY-2009	High
2.	PPPO-1 (EM/Paducah)	CD, ID , Modeling assistance in characterizing fissile materials in landfills	U mass limits as a function of enrichment, compounds & admixed materials	FY-2010	High
3.	SRS – 8 (WSRC)	CD, Measure adsorption of actinides onto MST & behavior of MST	Actinides plus Monosodium Titanate MST Salt Waste	CY-2012	Medium (SRNL will address)
4.	SRS – 3 (WSRC)	CD, Behavior of Fe, Gd, Pu in DWPF melter,	Non-MOX Pu Disposition	November, 2009	Medium (SRNL will address)
5.	SRS – 2 (WSRC)	CD, Solubility of Gd in nitric/formic acid	Non-MOX Pu Disposition	November, 2009	Medium (SRNL will address)

Notes: BD = Benchmark Data, CD = Chemical Data, ID = Integral Data

Nuclear Criticality Safety Technical Needs
EM-21 Workshop, June 2011
Summary of Needs for Source Data, Criticality Accident Alarm Systems, and Transport Methods Technologies

	DOE Site & Task (Organization)	Technical Area	Material(s) & Isotopes	Fiscal Year Required	Priority
1.	Hanford – 1 (TRU & CERCLA)	S/U, TM guidance - Complex-wide Standard	Transuranics	?	High
2.	SRS – 6 (WSRC)	S/U, TM Analyses of Pu in glass for the DWPF melter with absorbers: Fe, Gd, Na, Mn, B, Si	Non-MOX Pu Disposition with absorbers	November, 2009	Low
3.	ORO – 1 (Isotek)	TM plus I&C, Criticality detection system technologies for heavily-shielded operations	U-233, U-235, Gd, Cd as oxides, fluorides , in solution	FY-2009	High
4.	PPPO-2 (EM/PGDP & PORTS)	TM , I&C, Develop alternative CAAS requirements for cascade D&D	U in variable mass amounts distributed on equipment	?	Medium
5.	PPPO-3 (EM/PGDP & PORTS)	SD, TM , Modeling assistance, MCNP template	Neutron sources from U holdup	?	Medium
6.	PPPO-4 (EM/PGDP & PORTS)	SD, TM Modeling assistance in characterizing neutron background	Neutron sources from contaminants, soil and atmospheric components	?	Medium
7.	PPPO-5 (EM/PGDP & PORTS)	SD , Modeling assistance for specific activity of U-234	U-234 concentration as a function of cascade operation, decay data for neutron source term	FY-2009	Medium

Notes: SD = Source Data, I&C = Instruments & Controls, CAAS = Criticality Accident Alarm System, TM = Transport Methods, S/U = Sensitivity/Uncertainty